



A Unique Fin Design for Kinetic Energy Projectile

28 April 1999

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Firing Tables and Aeroballistics

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OUTLINE

- Background
- New Fin design
- AEDC Wind Tunnel Test Results
- TACOM-ARDEC Wind Tunnel Test results
- Conclusion



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Background

- When Kinetic Energy Projectiles Were Fired From A 120mm Smooth-Bore Tank Gun, Projectile Spin Is Needed To Minimize Target Impact Dispersion Due To Manufacturing Asymmetries.
- Aluminum Fins Burnt Due To Aerodynamic Heating - Unacceptable Target Impact Dispersion.
- The New Fin Concept Was Tested In The Supersonic Wind Tunnel At Arnold Engineering Development Center's VKF Facility (1987).
- This Fin Design Was Fabricated By Using Investment Cast Process And Test Fired At Yuma Proving Ground (1988).
- This Fin Design Was Fabricated With Thicker Fin Blade And Was Tested In ARDEC Supersonic Wind Tunnel (1990).



New Fin Design

- The L-tab Fin Design Consists Of A Small Fin Tab At The Tip And Normal To The Fin Blade.
- The Fin Tab Is Located On The Left Side Of The Fin Blade Looking Forward For Right Hand Spin.
- The Fin Tab Is At An Angle Of Inclination With Respect To The Projectile's Centerline To Produce An Offset Normal Force On The Fin Tab In Flight.
- This Concept Allows The Designer To Use High Melting Temperature Material, Such As Steel With Thin Fin Blades.
- The Novel Idea Of This Concept Is To Eliminate The Beveling/Chamfering Technique To Generate Roll Torque.

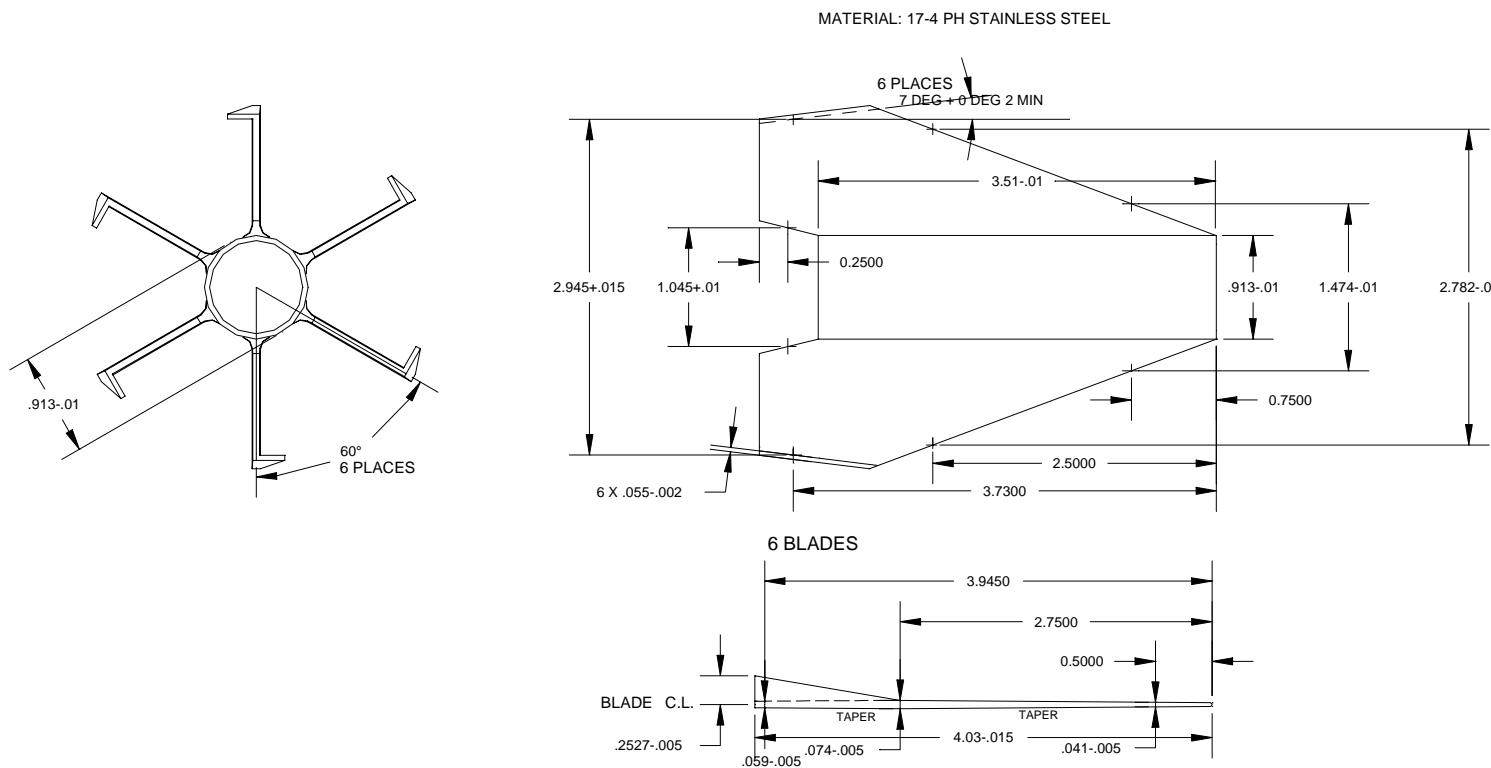


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New Fin Design

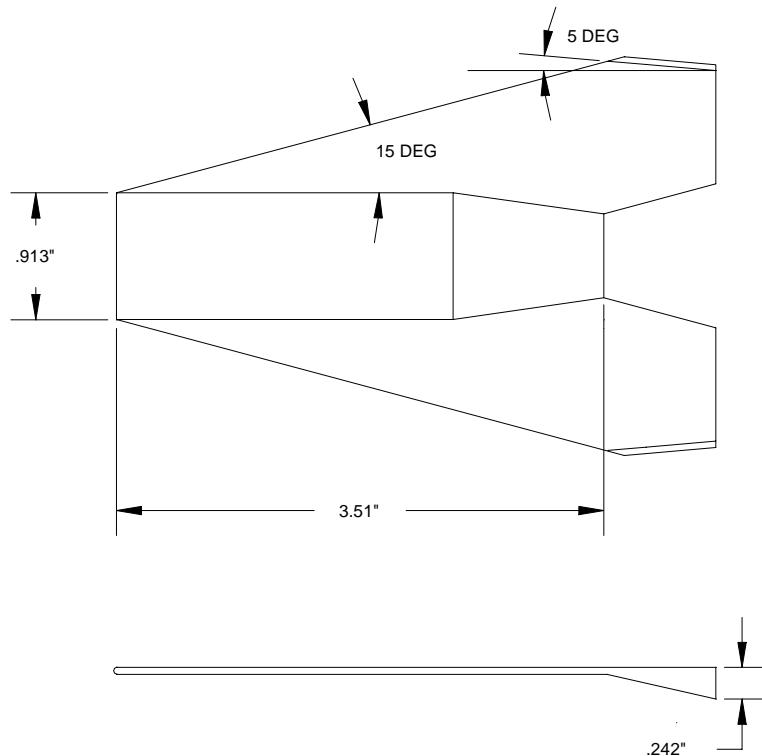
L-TAB FIN CONFIGURATION





New Fin Design

L-TAB FIN CONFIGURATION

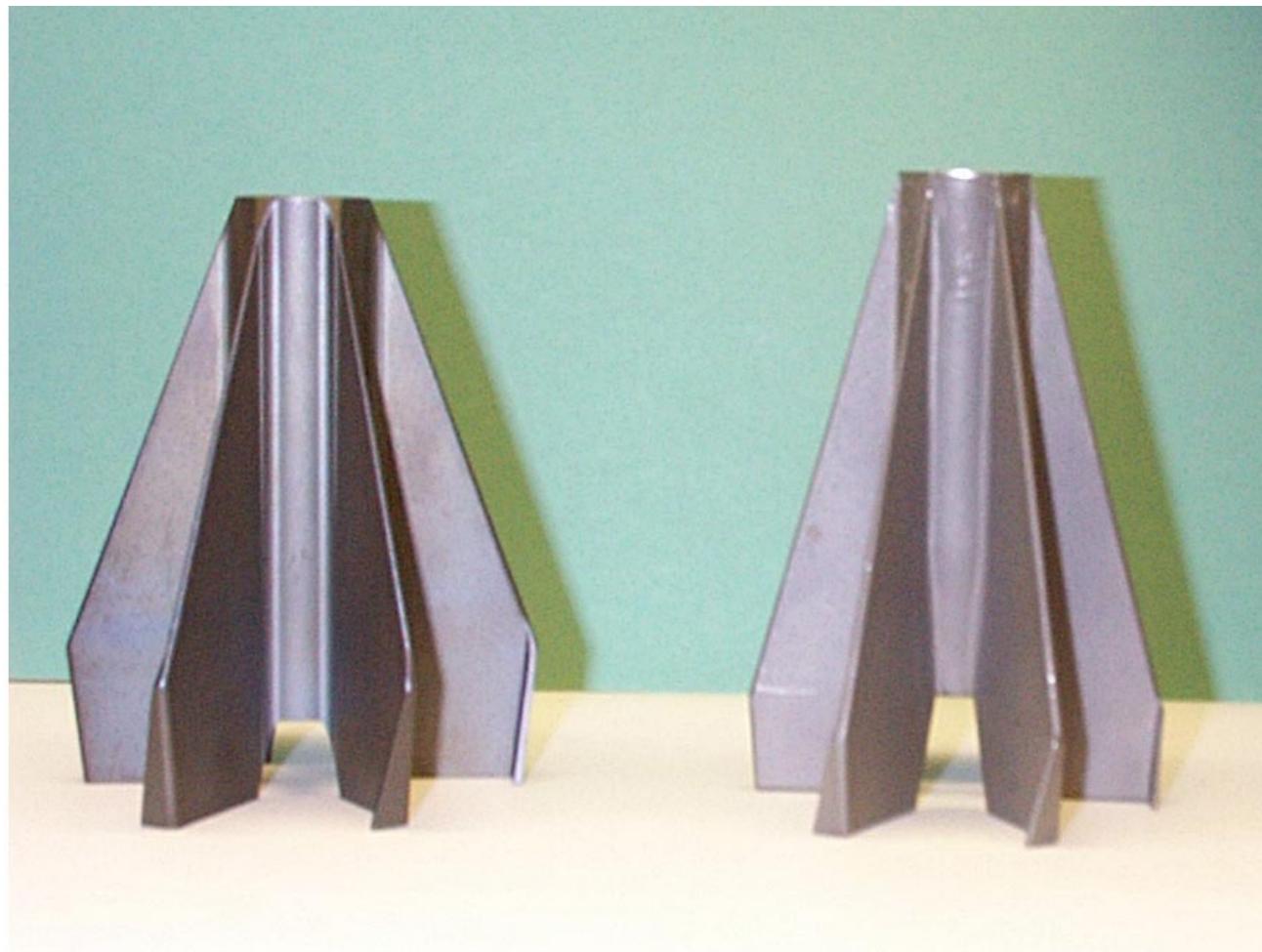




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New Fin Design



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AEDC Wind Tunnel Test Results

Fin Definition:

Fin 1: 20.5 deg leading edge angle, 3.176 cal span, 3.993 cal root chord, 3 degrees rear bevel, 0.807 cal tip chord.

Fin 5: 5.0 deg tab angle, 0.241 cal tab width, 4.233 cal root chord, 15.15 deg leading edge angle, 0.605 cal tip chord, 2.798 cal span.

Fin 6: Same as Fin 5 with 7 deg tab angle and 0.634 cal tip chord.

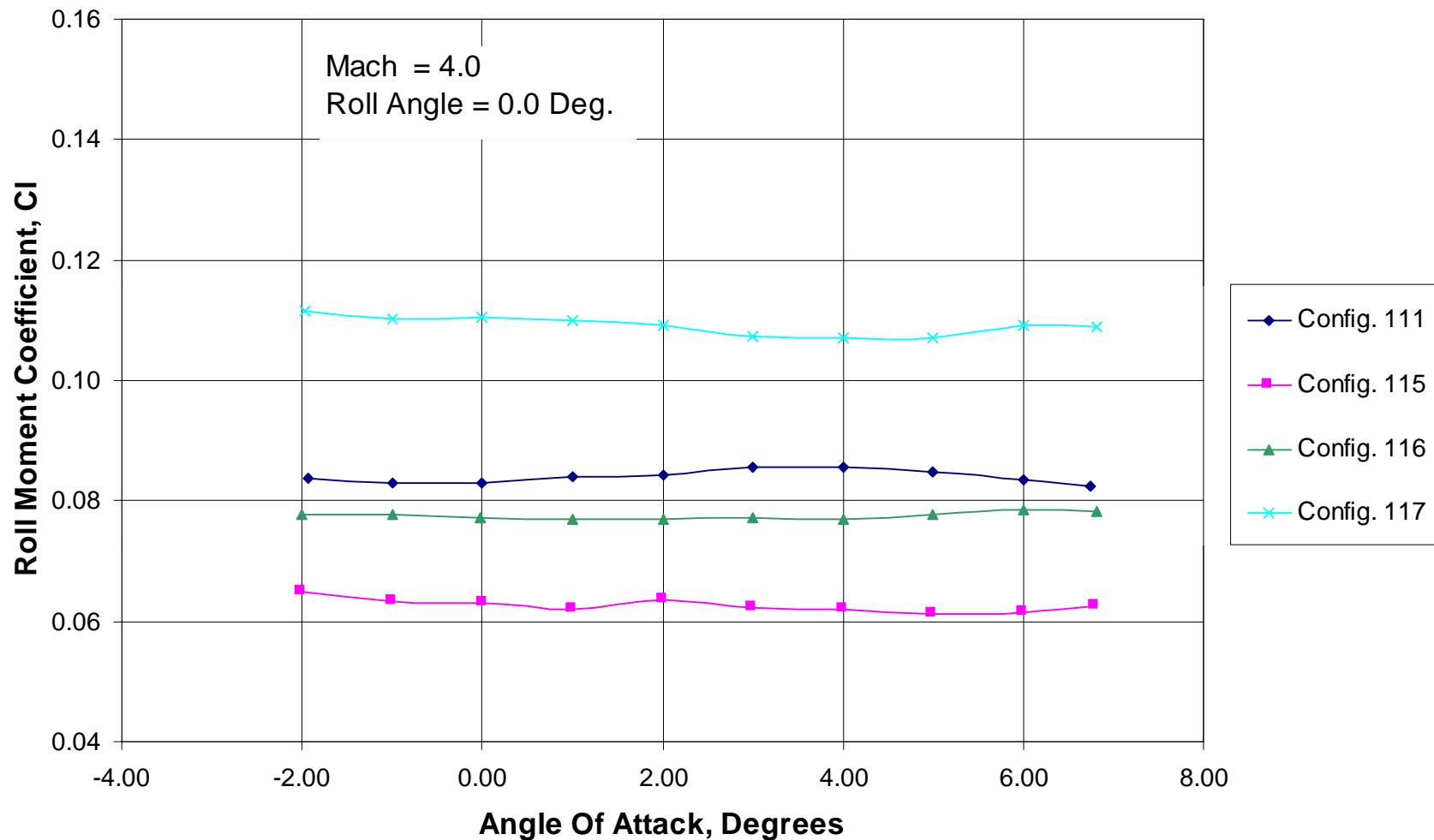
Fin 7: Same as Fin 5 with 0.362 cal tab width.



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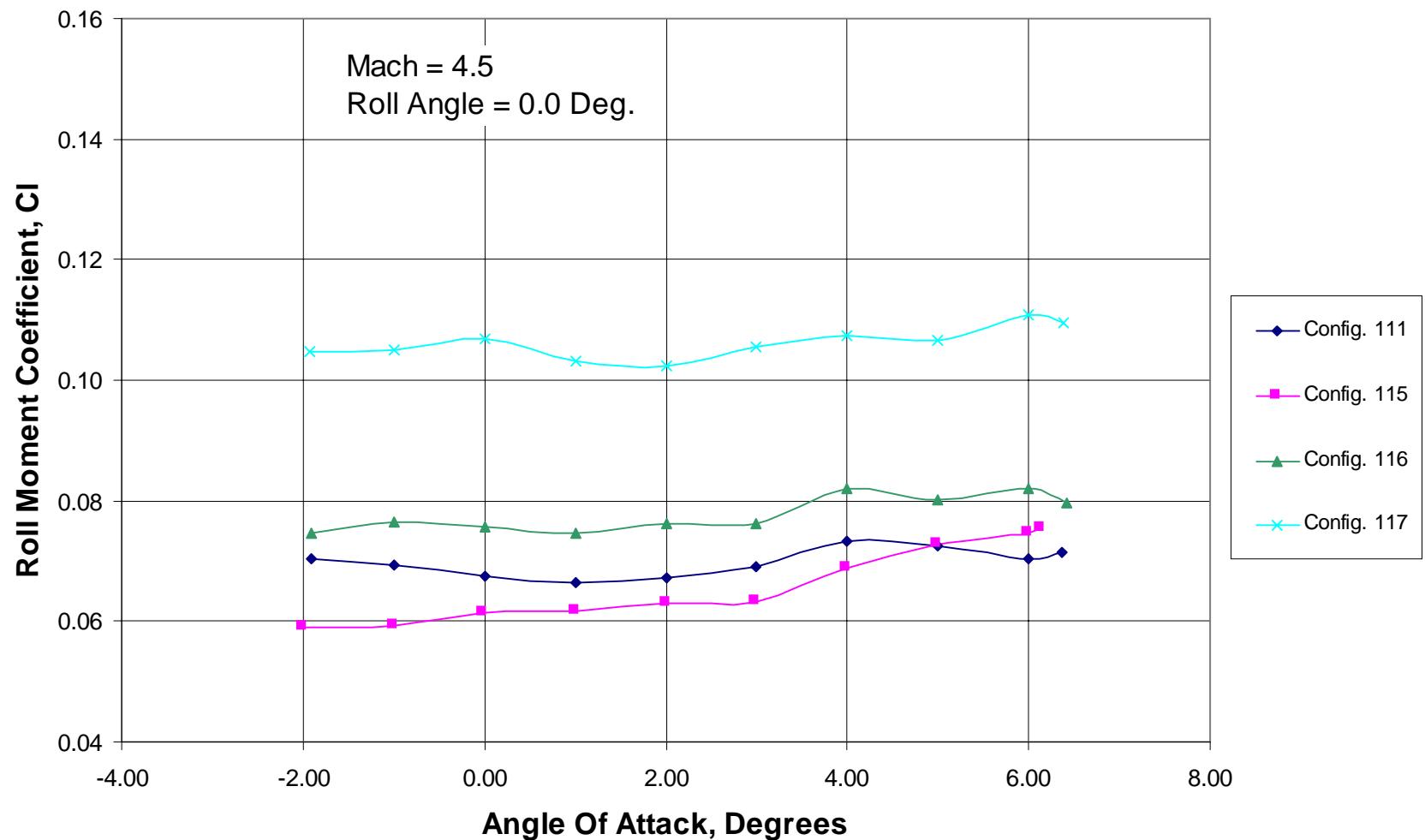




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AEDC Wind Tunnel Test Results



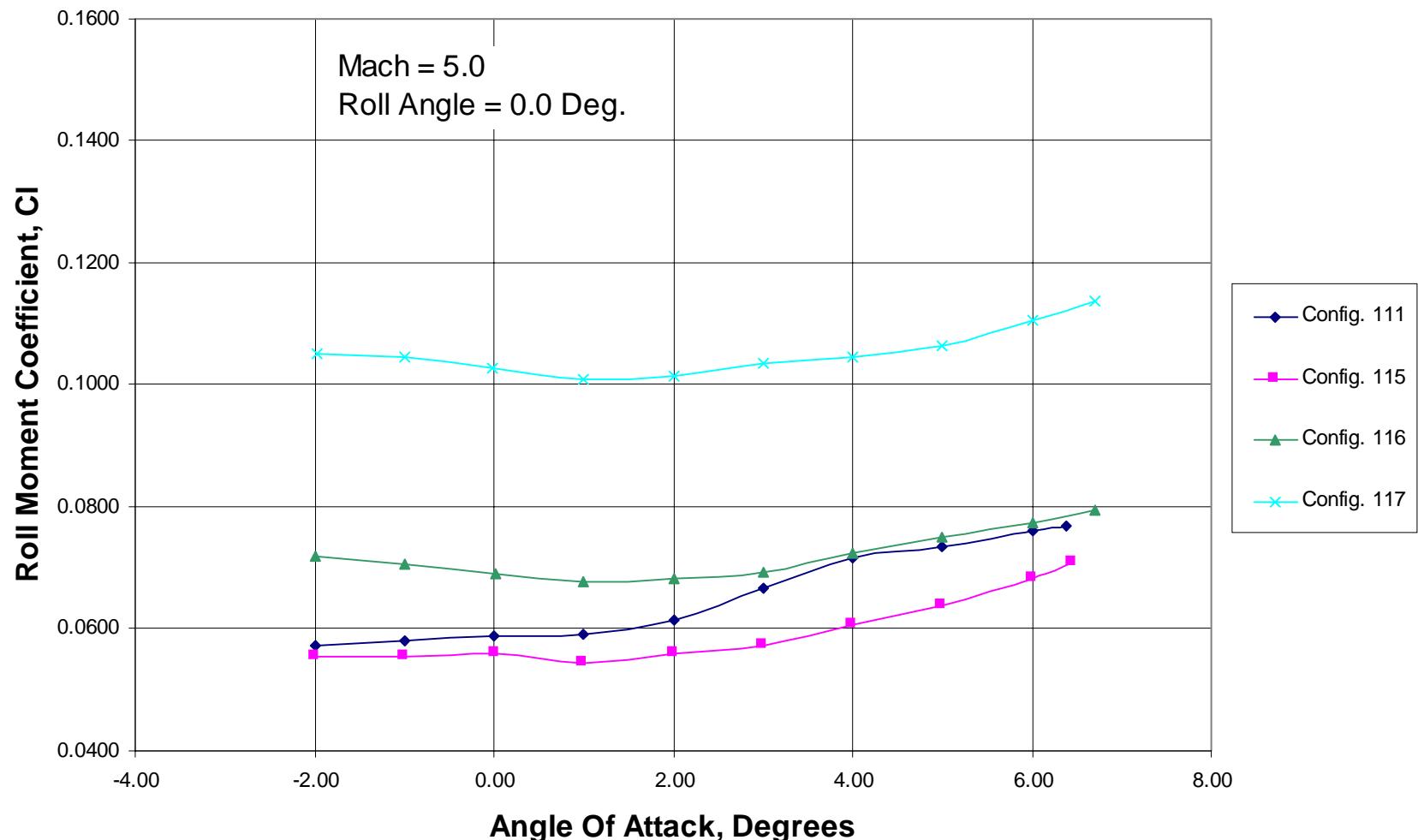
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AEDC Wind Tunnel Test Results



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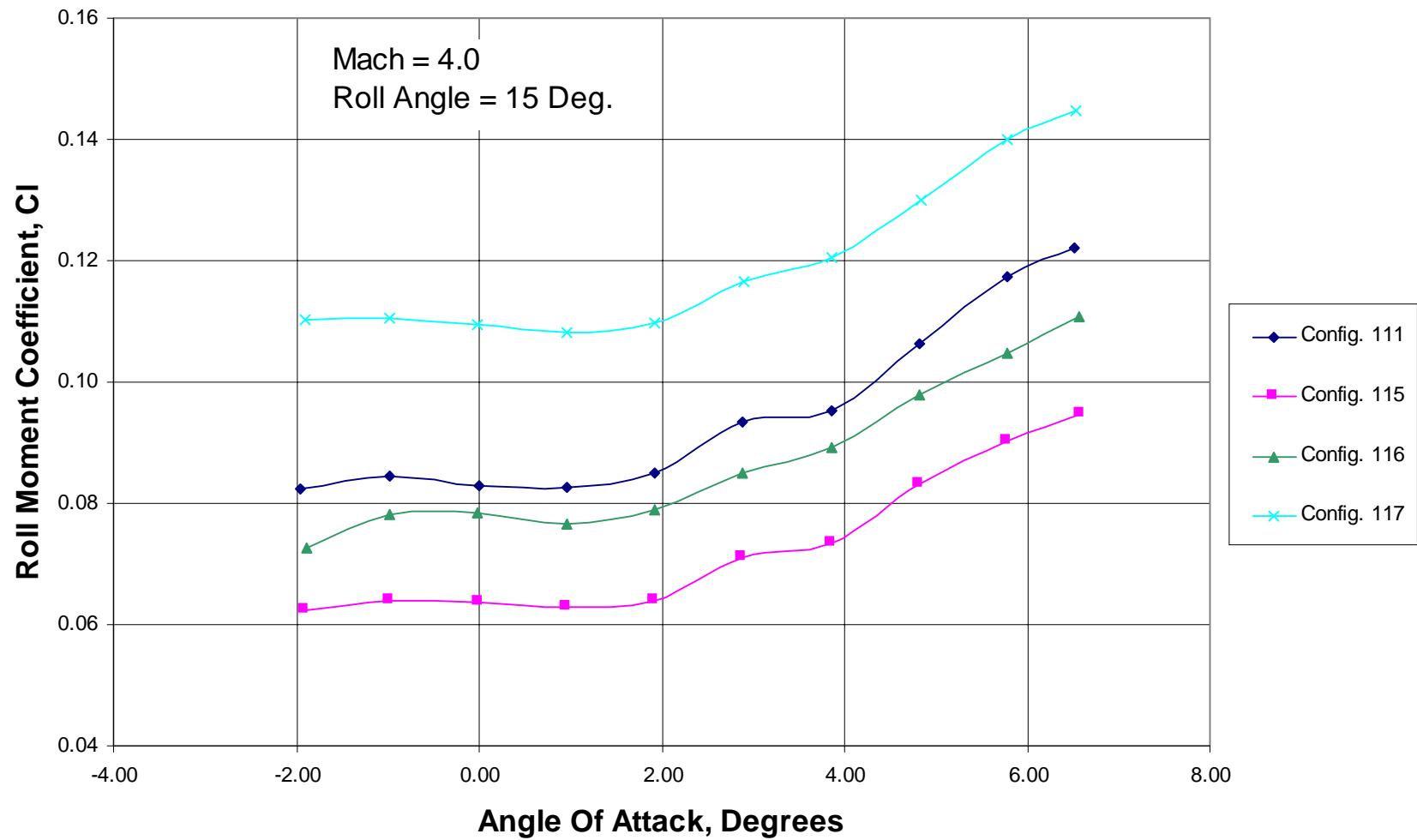
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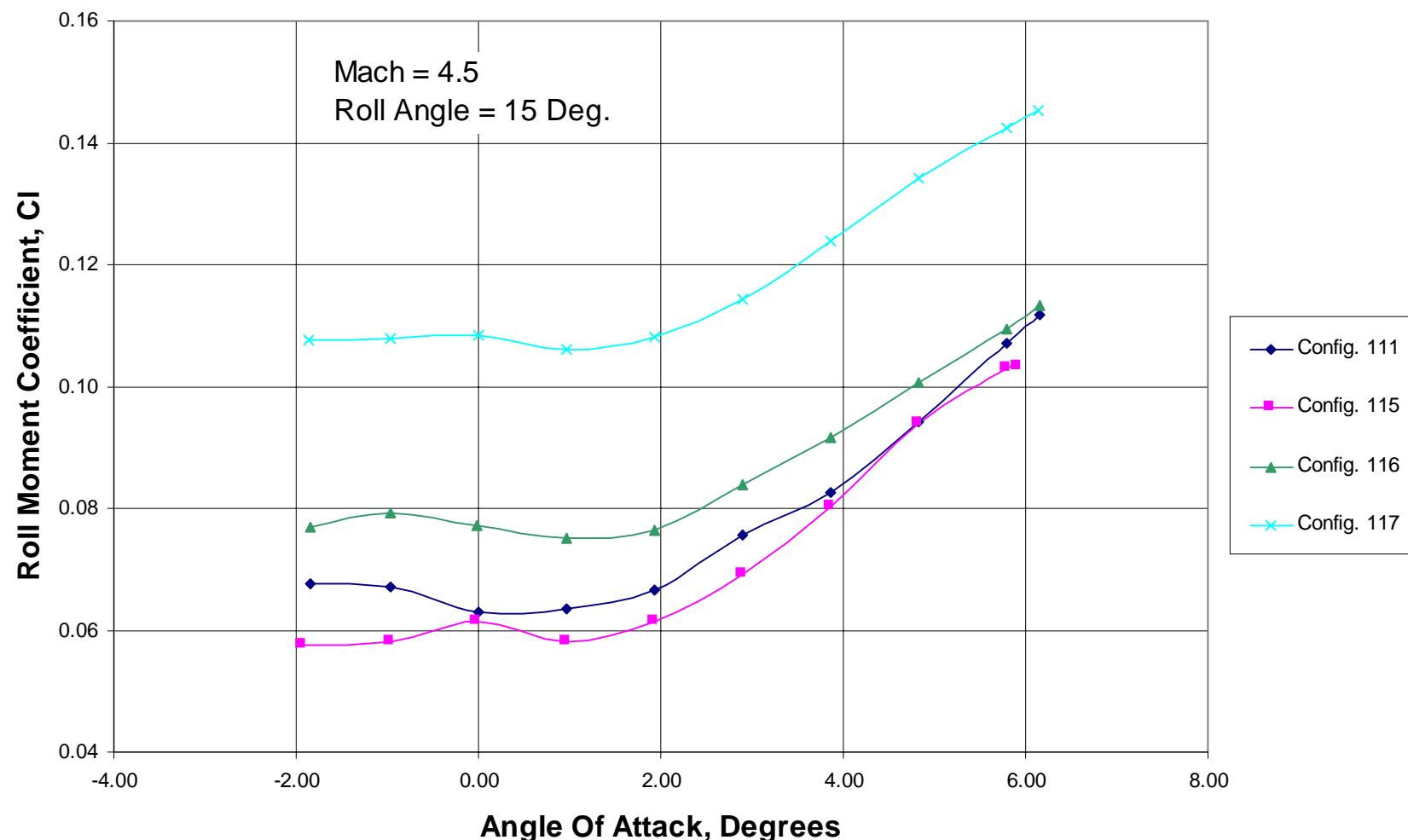




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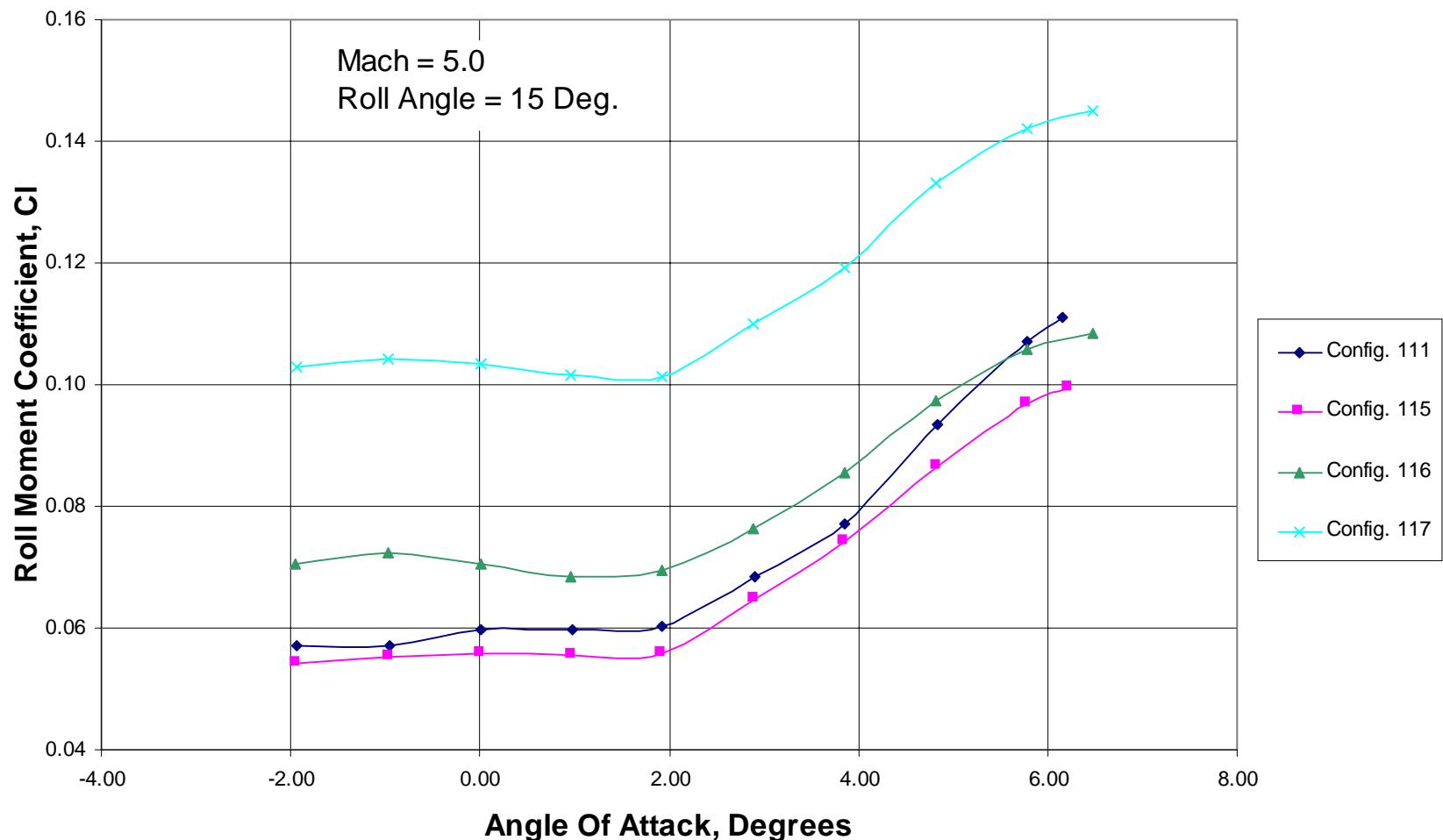
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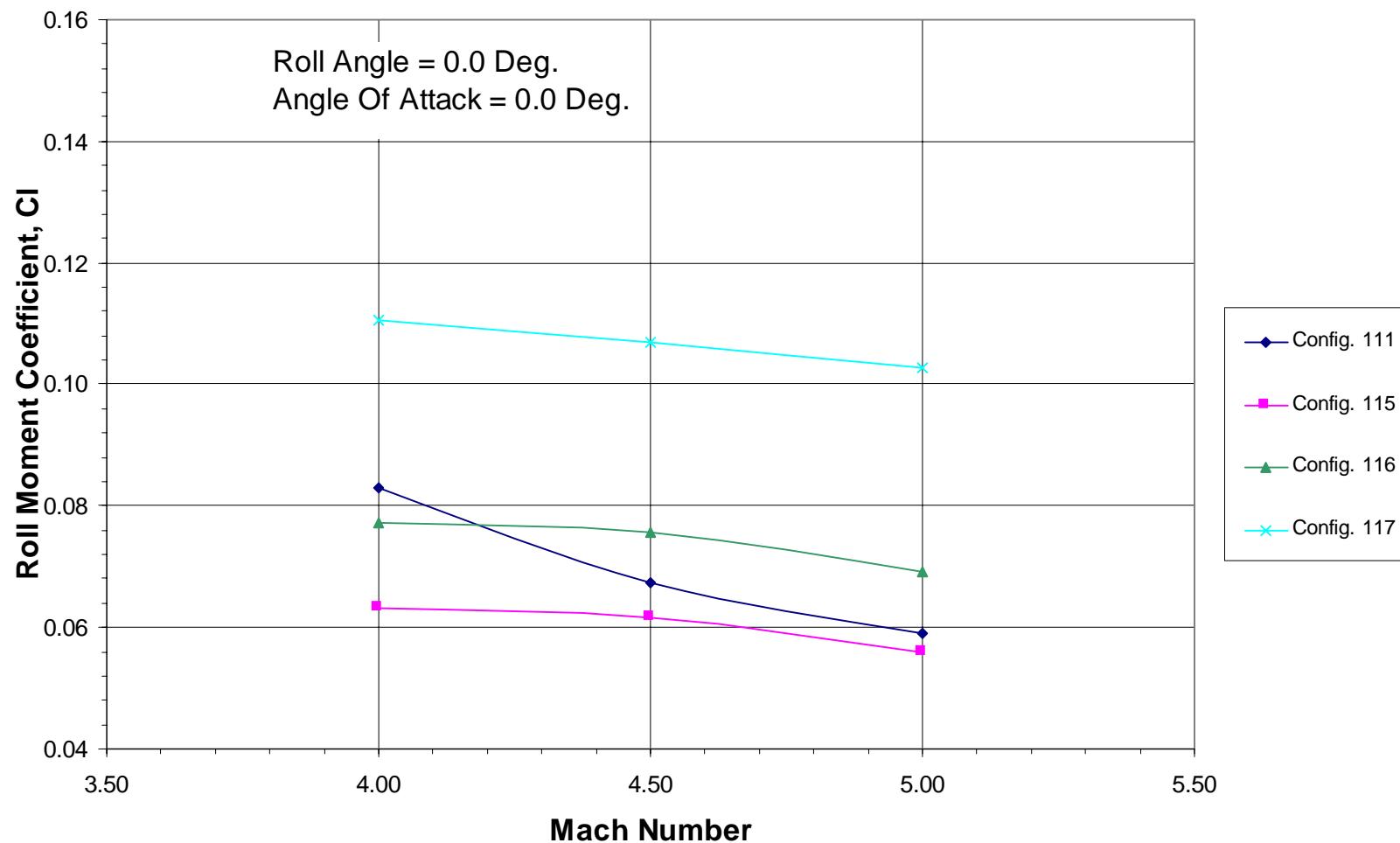




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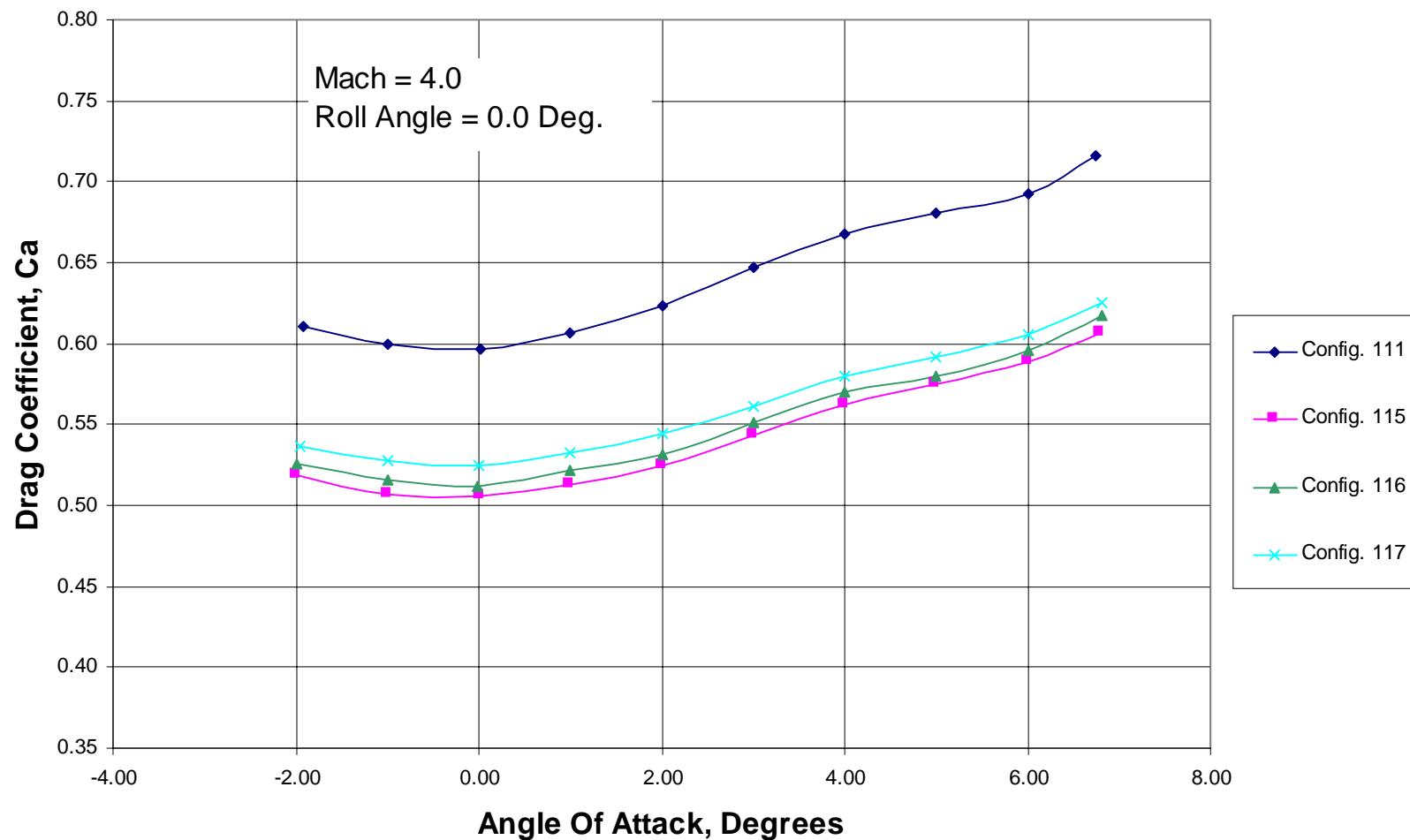




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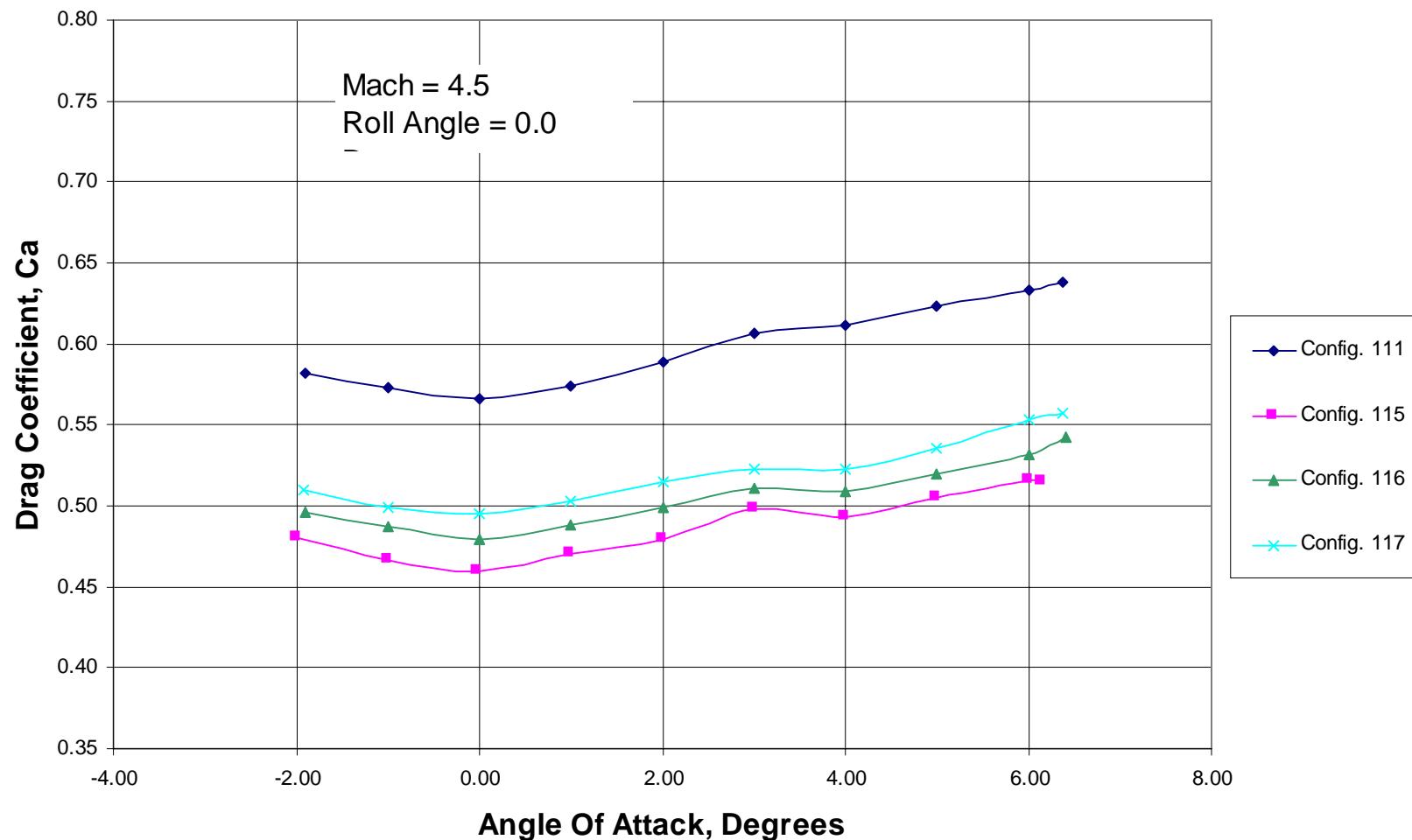




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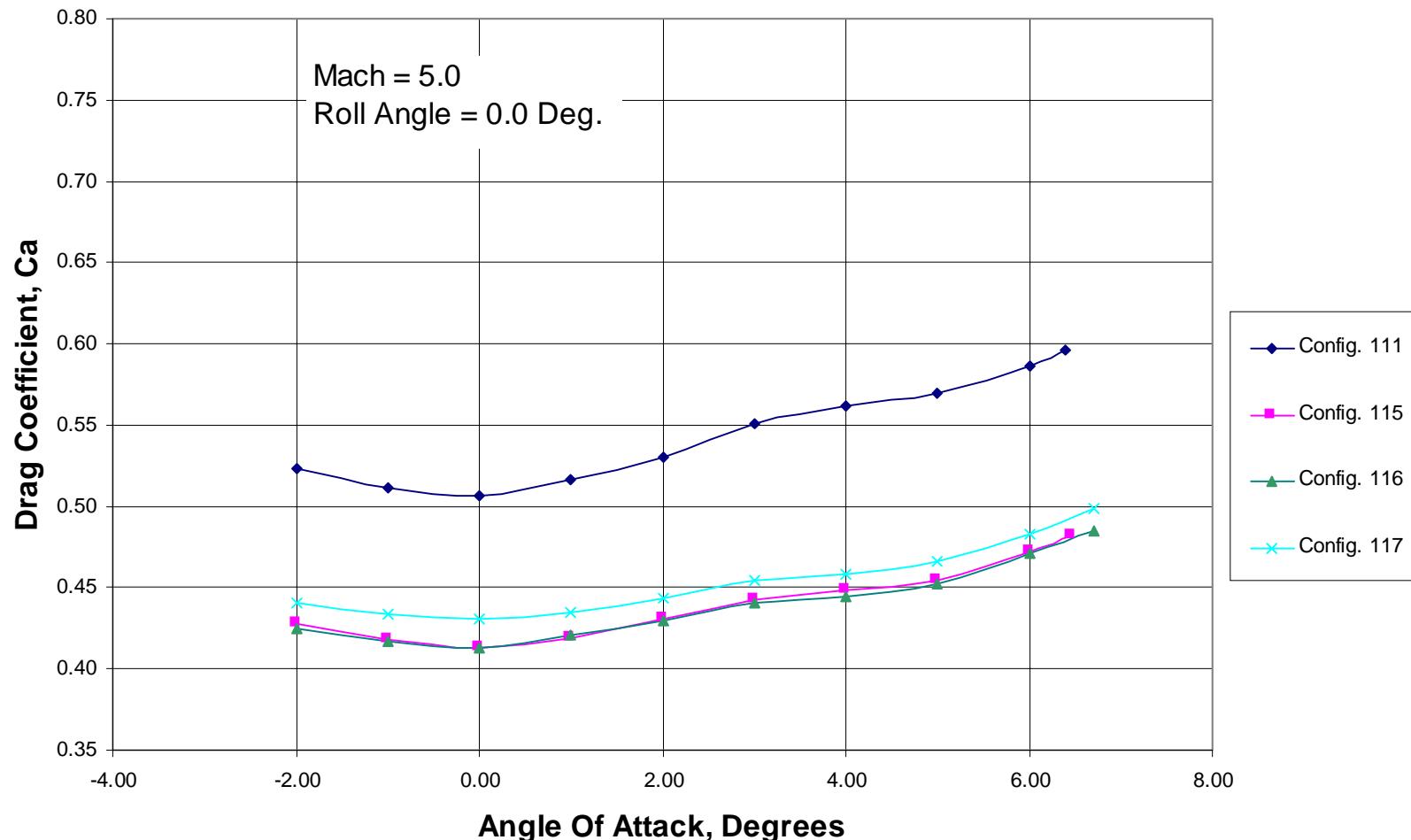




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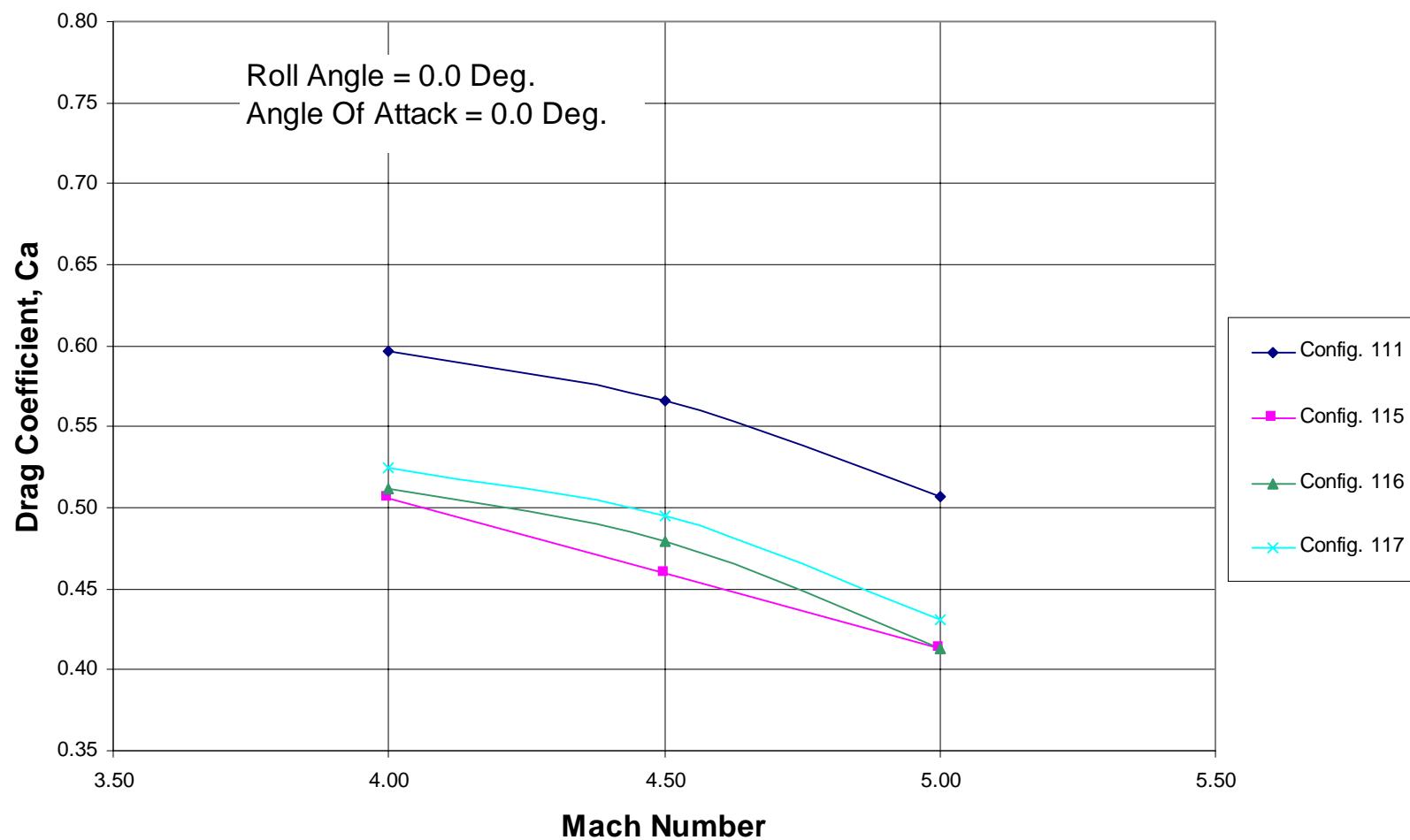




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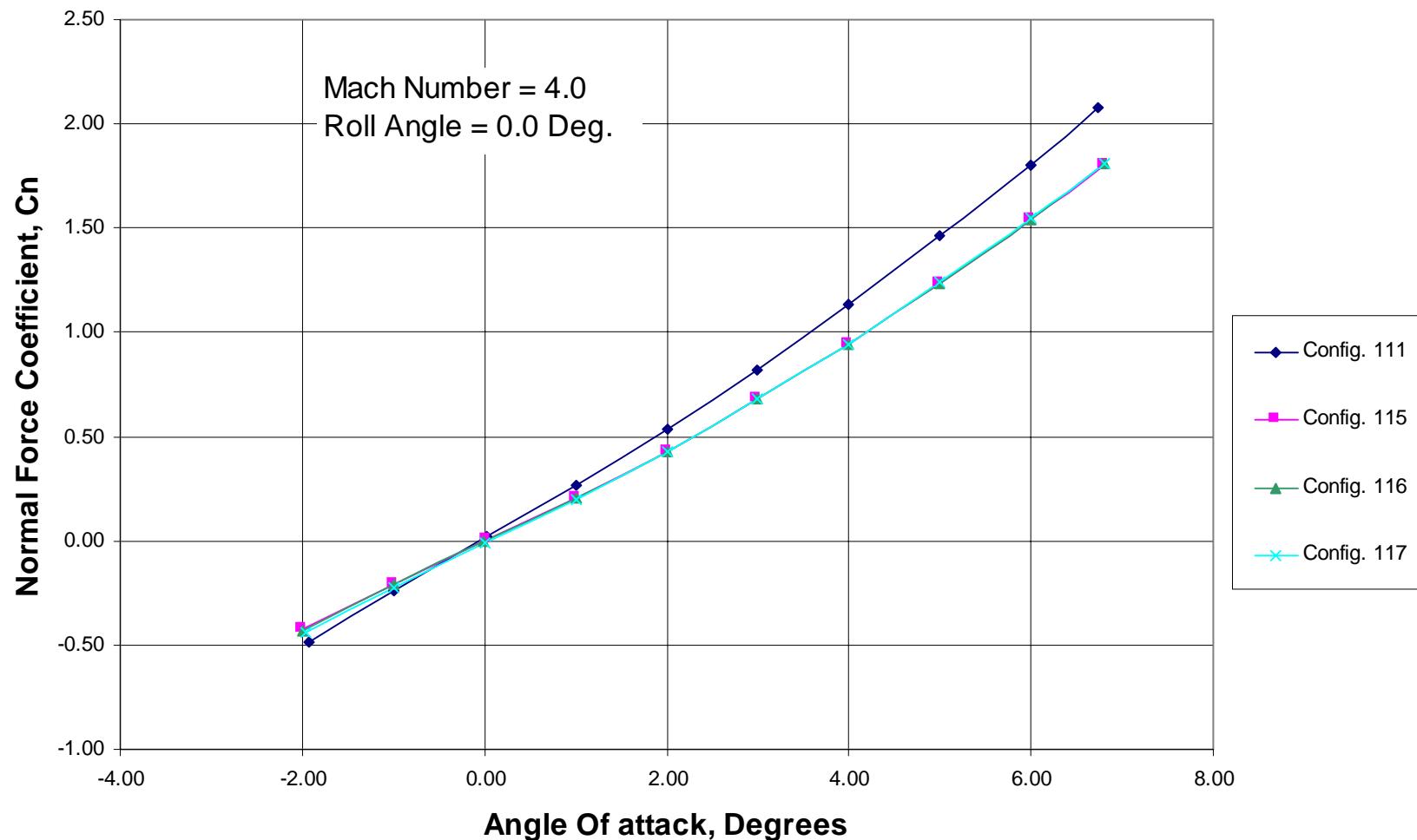




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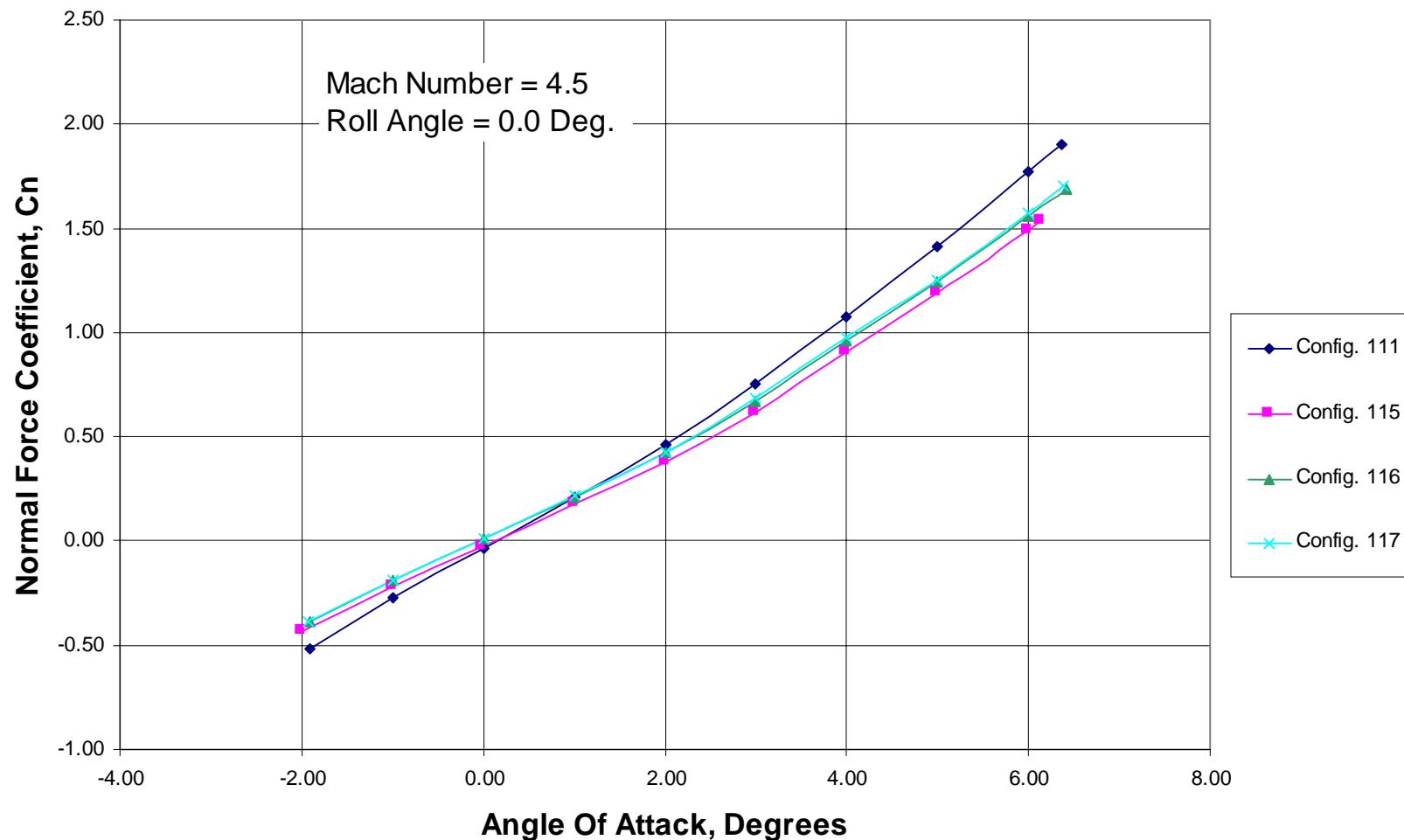




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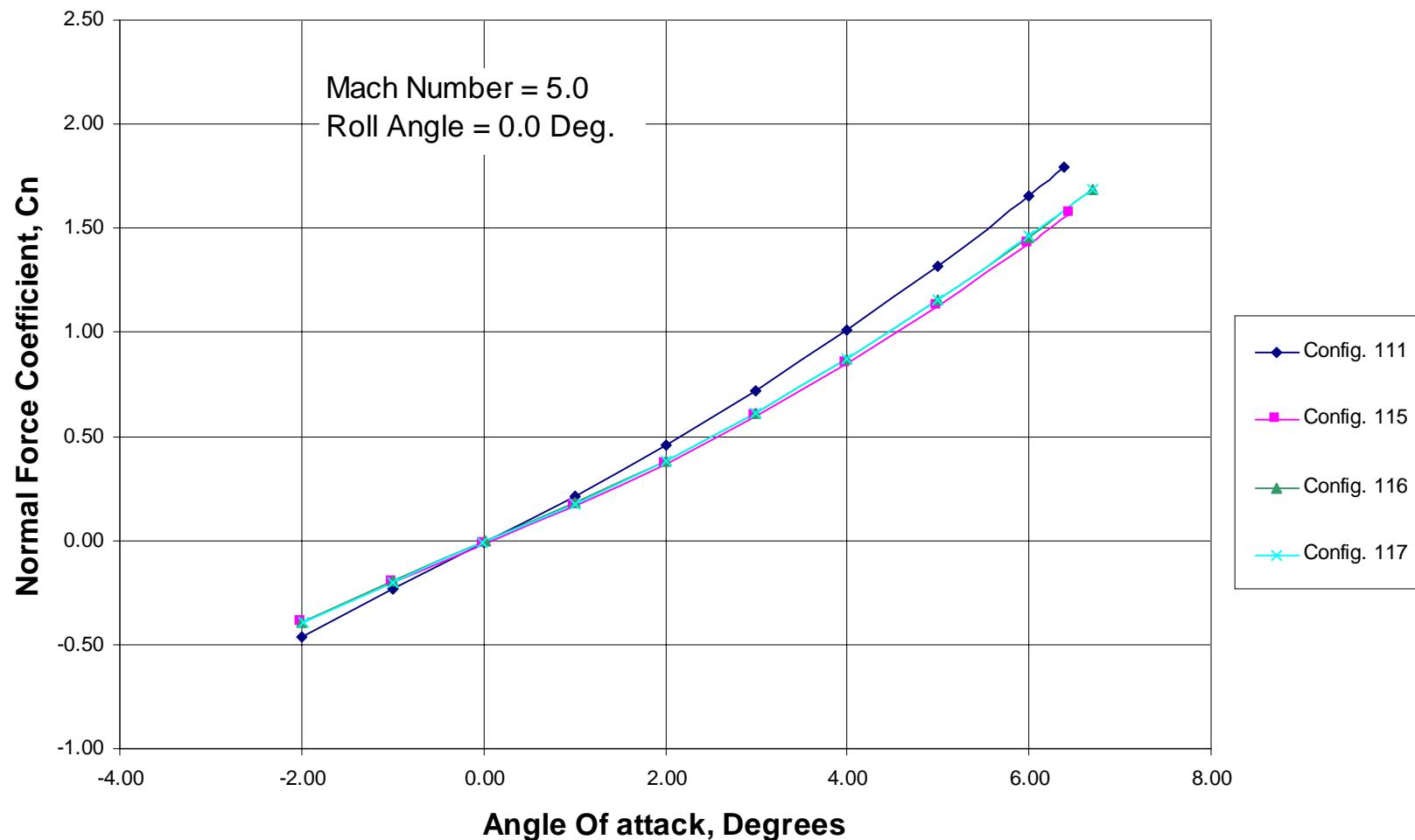




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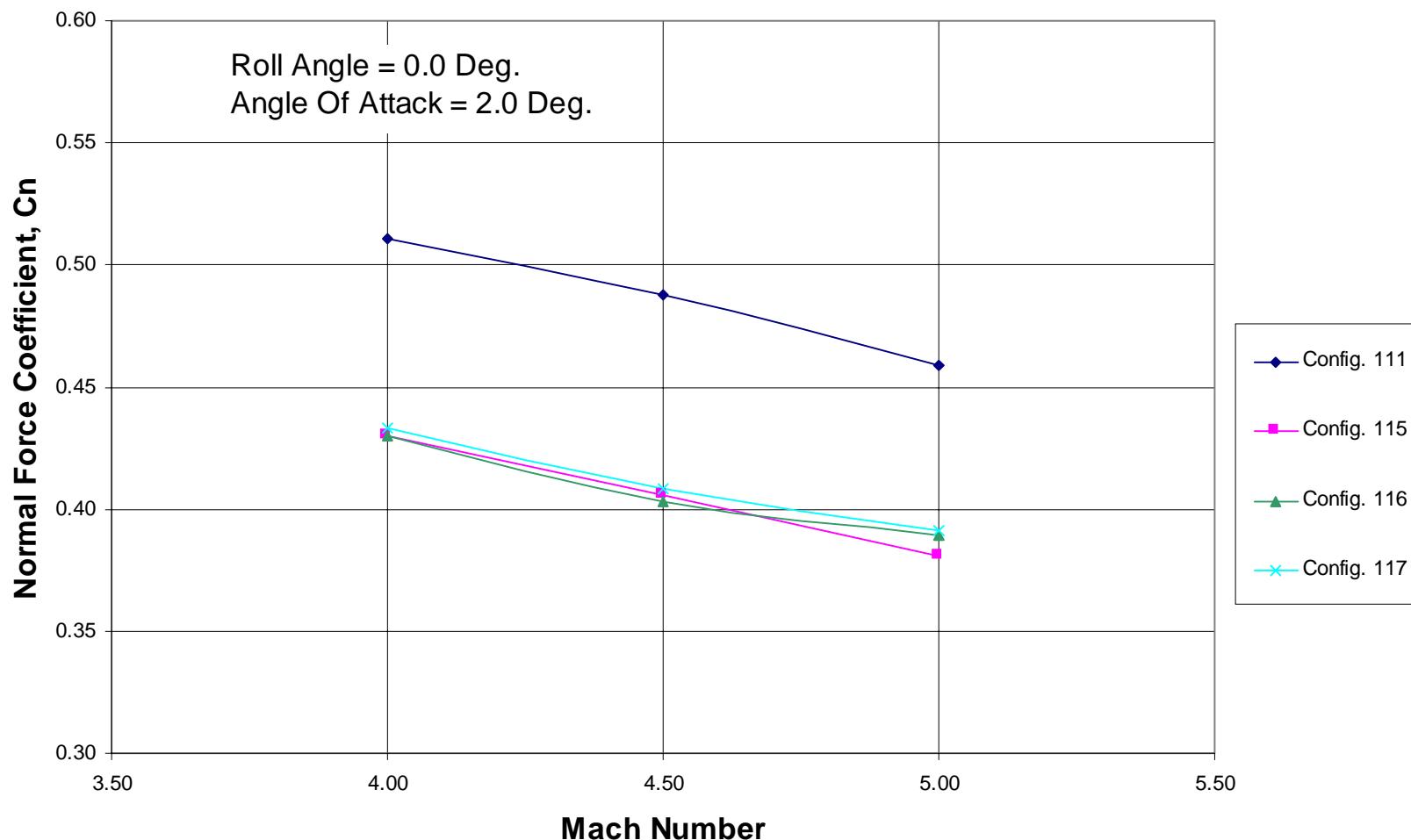




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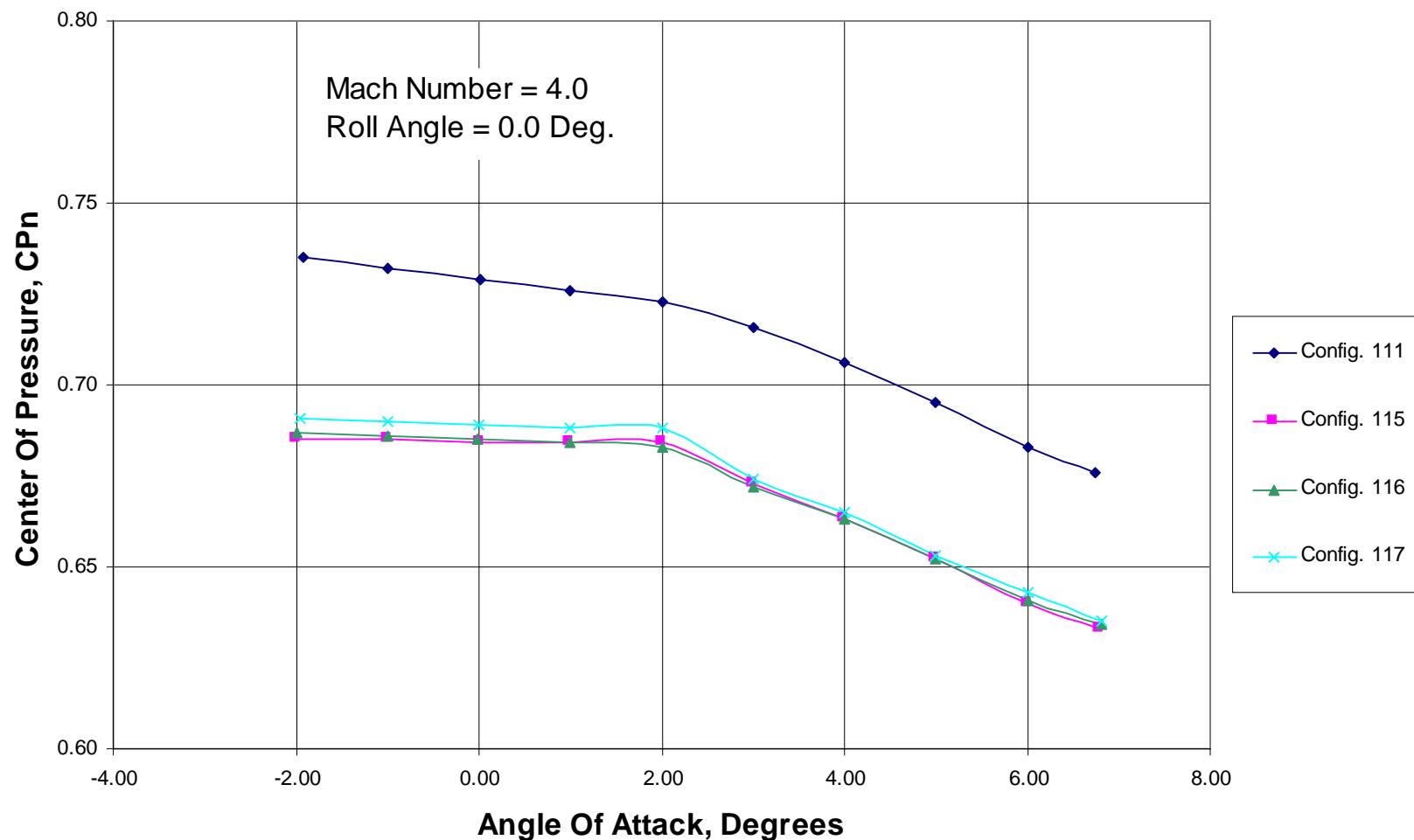




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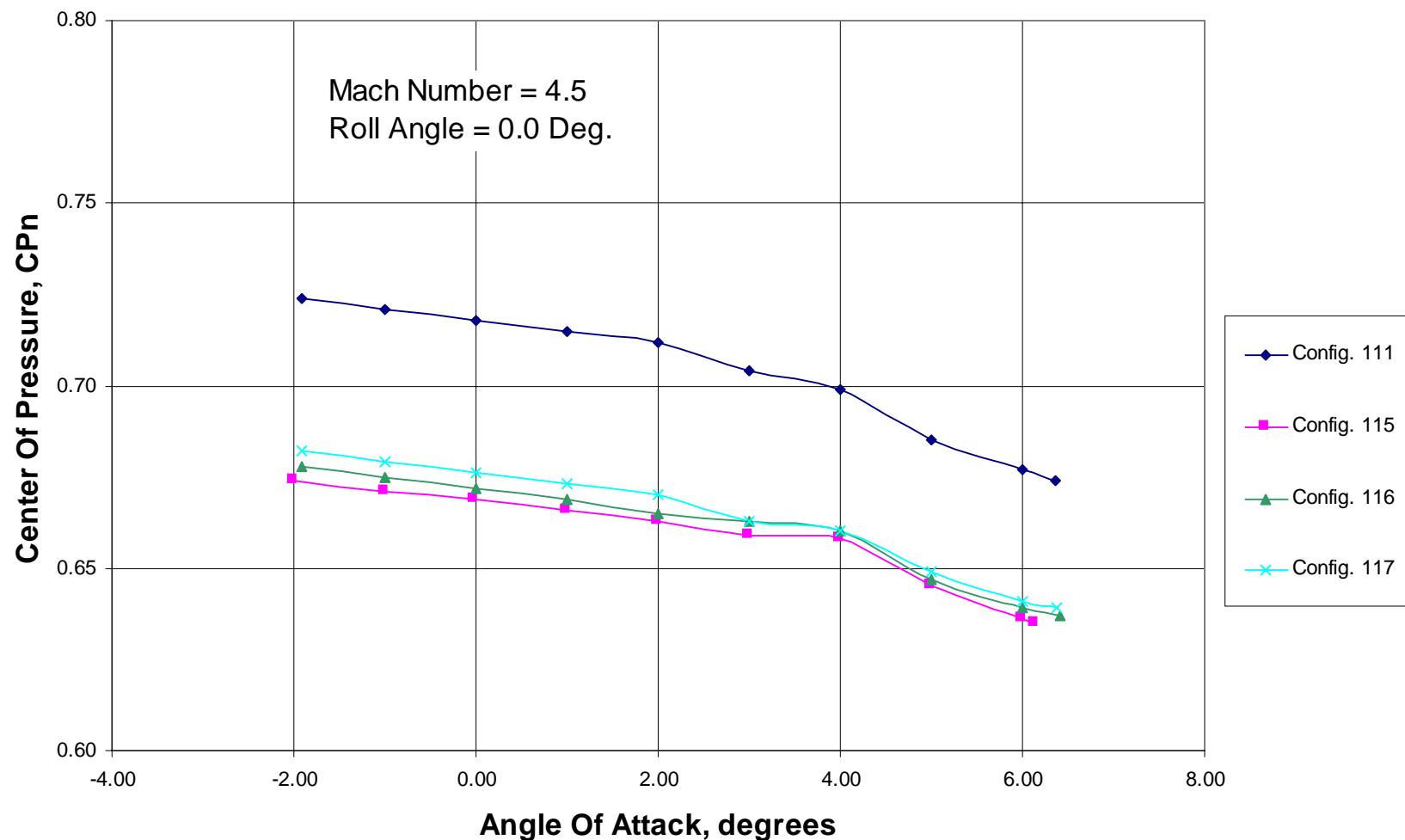




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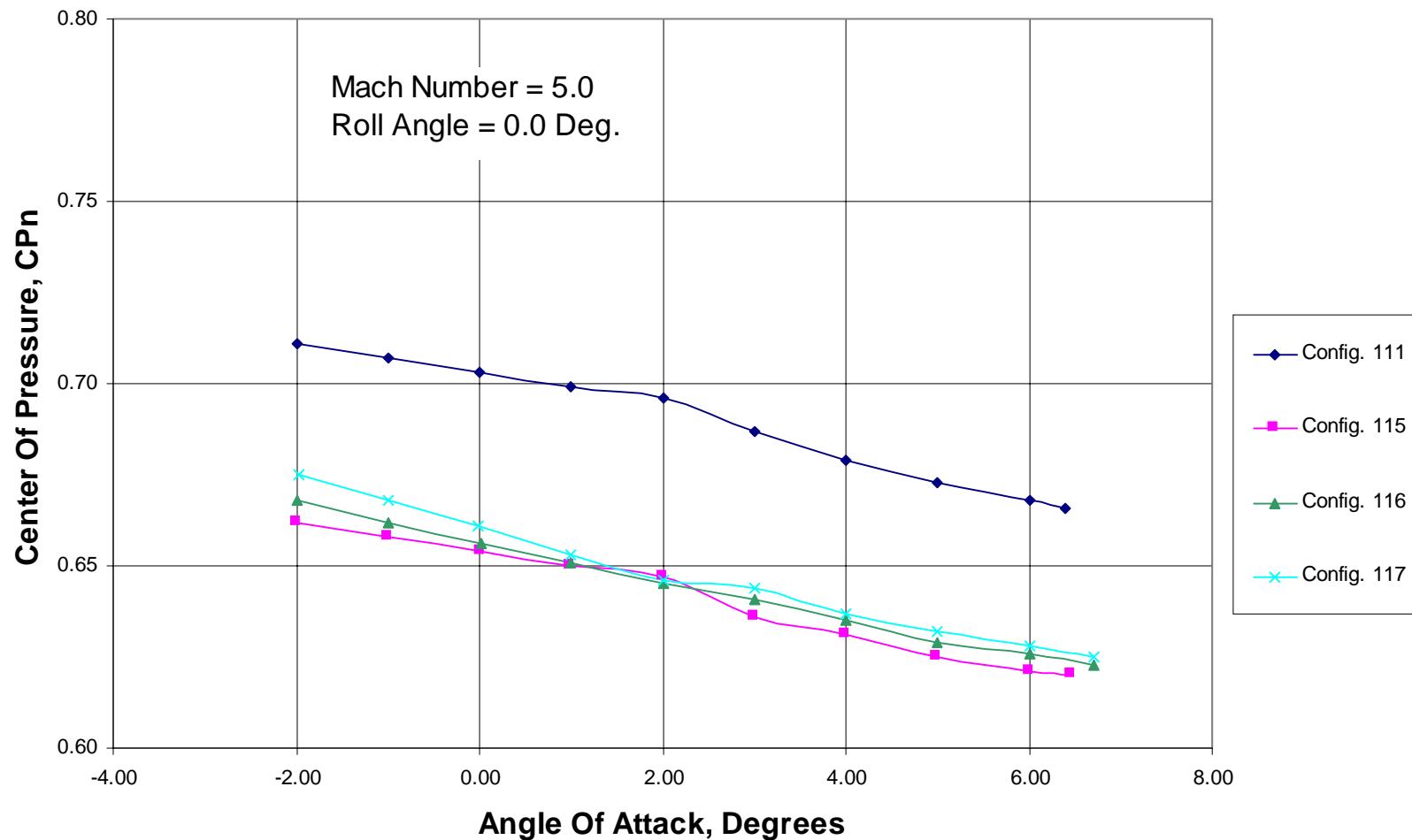




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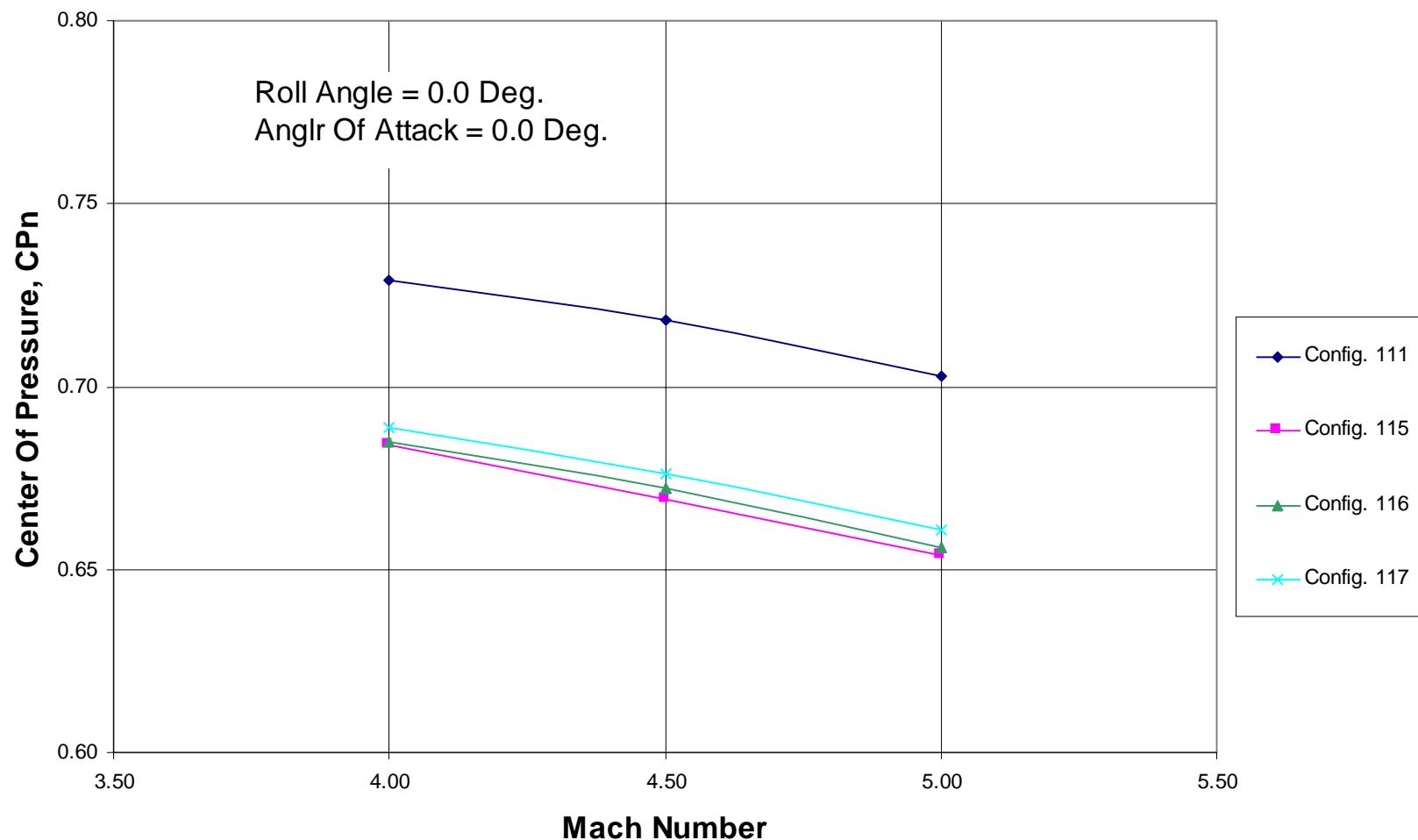




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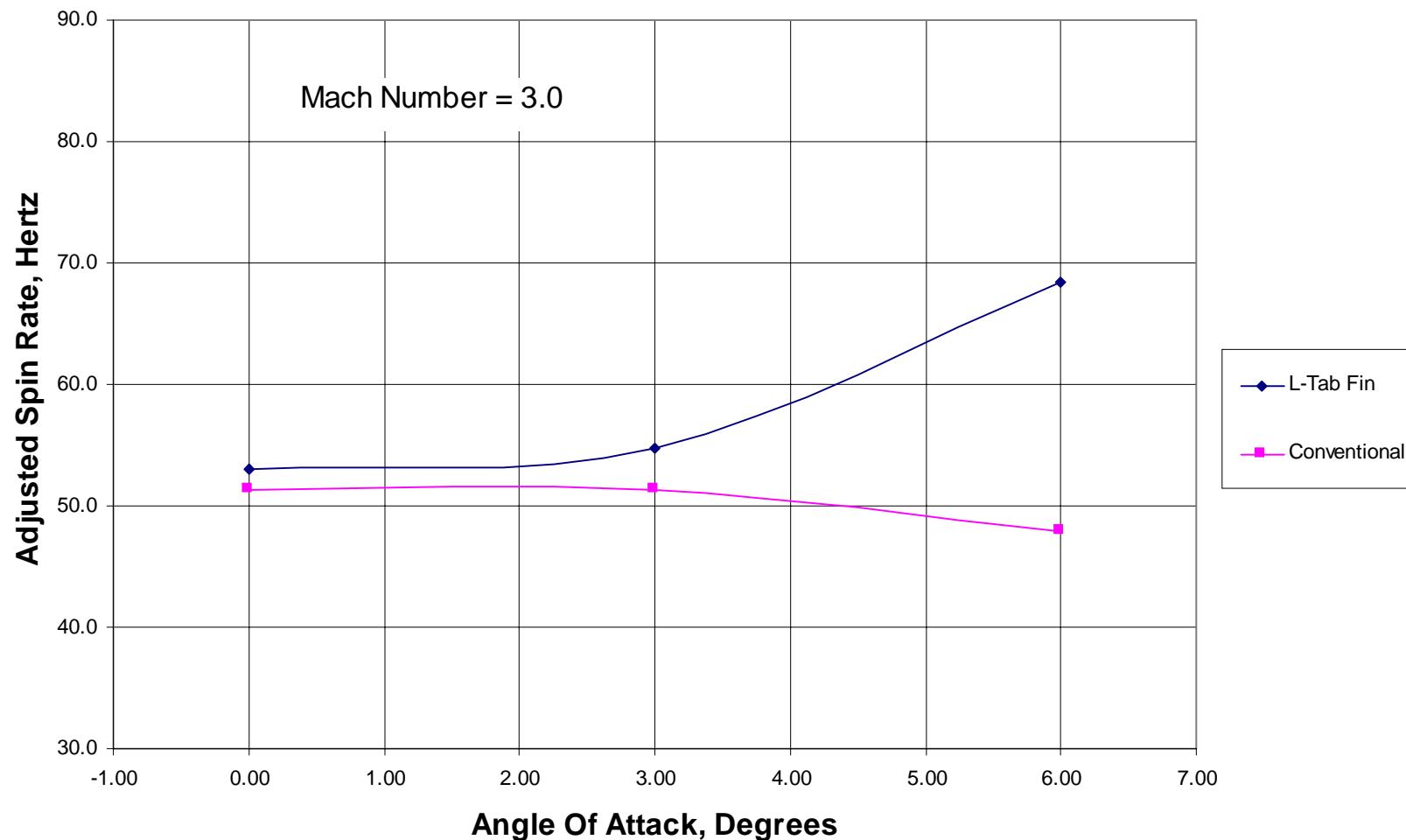




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TACOM-AEDC Wind Tunnel Test Results

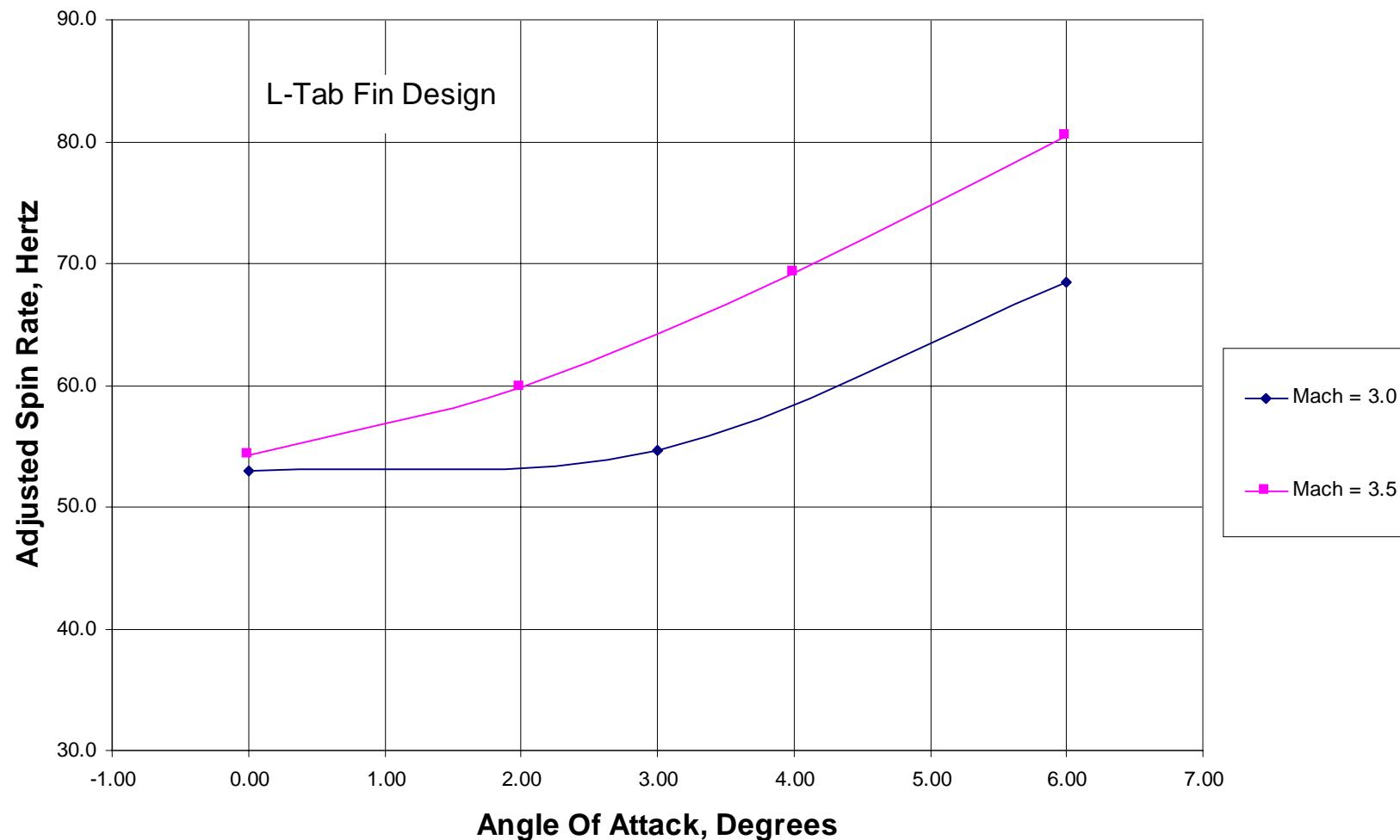




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TACOM-AEDC Wind Tunnel Test Results



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Conclusion

Advantages:

- Eliminate Fin Abrasion Due To Aerodynamic Heating In Flight .
- Eliminate Non-Uniform Coating Thickness On Aluminum Fin Blades.
- Lower Drag And Higher Stability (Same Fin Span).
- Simple Fin Blade Cross Section Design.
- Higher Roll Moment At Higher Angle-Of-Attack Shown In TACOM-ARDEC Wind Tunnel Test - Spin Pass Through Resonant Frequency Faster.



Conclusion

Potential Problems:

- Fabrication - Possible Investment Cast.
- Structure Integrity At Launch.